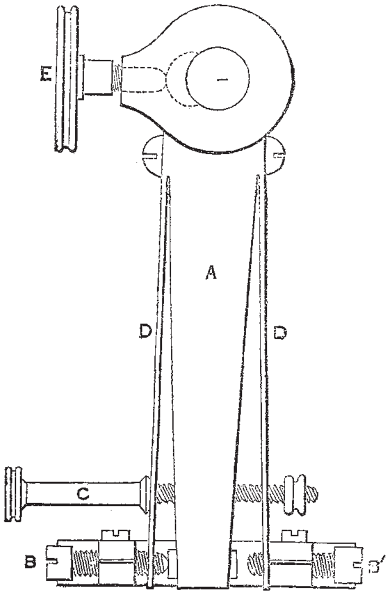
it among their twenty-eight publications marked "OFFICIAL;" and the more so inasmuch as its teaching directly tends to overturn the rules which guide seamen in storms and hurricanes, as well as the first principles of atmospheric physics.

GENTILLI'S TACHEOMETER

AMONG the instruments exhibited in the South Kensington Loan Collection is one likely to prove of great use in survey-making; it is the invention of M. Gentilli, an Austrian engineer, and its main purpose is to accomplish rapid surveys (hence its name) of difficult country. Not only does it survey the ground, but it gives the height and distance of every point surveyed. The instrument itself differs little from an ordinary surveying telescope. A vertical lever, A, is attached to the axis of the telescope by means of a screw, C (in figure); this lever moves the axis through a given angle, which can be exactly adjusted by means of the two stops, B B′, opposite the free end of the lever. The points to be surveyed are marked by a surveying staff, on which are shown in a manner to be visible at a great distance, very minute divisions of a foot. The telescope is pointed to this distant staff of which it measures: (*a*) the horizontal angle of position, (*b*) the vertical angle of elevation, (*c*) the distance of the instrument from the staff. It is the accuracy with which this last



datum can be read that is accomplished by the peculiar mechanism of Gentilli's instrument. As an example: Suppose the staff marked with divisions, to have a scale of 12 feet, on which feet, inches, and eighths of an inch are shown. The telescope is directed to the top of the scale, of which it gives the horizontal and the vertical angle. It is next directed downwards by the screw to a fixed stop, and there it reads on the staff, say 10 feet 5 inches below the former reading; that distance on the staff is 1,000 eighths of an inch, and tells us that the staff is 2,000 yards off. In short, the greater the angle through which the telescope is moved, the greater the distance and *vice versâ*, Gentilli's telescope reading the distance and giving it exactly as read, without calculation of any kind. The mechanism is so precise that the telescope can be moved through any given angle and restored to its original position with almost perfect accuracy. Practice has shown that the distances so measured by a small instrument of only 40 magnifying power are correct to within $\frac{1}{2000}$ part. The instrument seems likely to be of the greatest use both to ordinary surveyors and to those who have to carry on extensive topographical operations.

THE RADIOMETER IN FRANCE

ALTHOUGH Mr. Crookes's apparatus was described in a few French papers at the end of last year, the novelty of the phenomenon has prevented physicists from paying due attention to it till within the last three months. But now the subject has been brought before the Institute and a number of experiments have been made or are being contemplated which are deserving of notice.

The first apparatus in Paris were procured from London, and also from Germany by Geissler; but now they are exported from Paris. There are in Paris not less than three makers—M. Gaeffe, M. Alvergniat, and M. Saleron—who are daily selling the apparatus, so that the instrument will soon become common in all laboratories in spite of the price, which is about 25 francs.

M. Fizeau, the well-known physicist, has stepped forward to defend the theory of air-dilatation. The most formidable objection was proposed by M. Ledieu before the Institute. This mathematician insists upon the great fact that in the air at the ordinary pressure the blackened plate is attracted instead of being repelled. He says that there is a decided opposition between these two phenomena, and that at a certain pressure the radiometer cannot move at all. I do not know whether the experiment has been actually tried. The best plan for investigating the question is to construct radiometers in different gases, carbonic acid and hydrogen, which I intend to do. If the rotation is produced merely by dilatation of the residual gas the motion must be quicker in hydrogen and slower in carbonic acid, owing to the difference of conducting power and mobility. But even then it remains to account for the inversion of rotation.

Sometimes the radiometer rotates in an opposite direction without any apparent cause operating upon it. In investigating the question I demonstrated very simply that this is because it emits heat. To obtain inverse rotation it is sufficient to leave it for some length of time exposed to the rays of the sun, or to the radiation of a furnace, and to plunge it in a vessel full of cold water. The effect is immediate, the inversion takes place almost instantly; but the real quantity of heat accumulated in plates being very small indeed, the inverse rotation is accelerated for a few seconds, and diminishes at a very rapid rate. In less than half a minute the radiometer stops, and direct action of the rays causes it to rotate again in the direct way if the vessel is of glass and transparent. The same experiment can be made in the shade, but it requires more caution, as the inverse action is less powerful, and the light can operate with sufficient force to continue the rotation in the normal direction, in spite of reverse force produced by refrigeration. But even in these cases it is possible to perceive a diminution in the rate of rotation. The radiometer falls to a rate which is smaller than the final one, and suffers a visible augmentation after a temporary diminution in the first instance.

M. Alvergniat exhibited, at a recent sitting of the Société de Physique, a double apparatus to demonstrate that the position of the blackened face determines the direction of rotation. The following experiments can be made with a radiometer with both plates blackened, and illustrate the same fact with greater simplicity if the half of the transparent sphere has been previously blackened.

If the blackened hemisphere is perpendicular to the rays, the radiometer will remain motionless; but in an oblique direction it will rotate to the left or to the right, according to the inclination of the incident rays. The least surplus in the quantity of light or heat received by any influenced surface will rotate the apparatus in the direction of repulsion.

M. Saleron made an experiment suggested by M. Ledieu, and which is a consequence of the fact above mentioned. If the light is received alongside the axis, the radiometer rotates. The velocity of the rotation is not yet in our hands.

The reflection of the light on the glass creates a disturbing force, as it is easy to show by the following experiment, which I made before the Academy of Sciences :—The bulb of an ordinary radiometer being half blackened, the rotation takes place in the same direction, whatever be the position of the blackened hemisphere, but at different rates. With the light falling on the white side, the rotation is reduced to about $\frac{1}{4}$, and about $\frac{3}{4}$ when falling on the blackened side. Both numbers give exactly 1, *i.e.*, the regular number of the translucid sphere. Consequently, I suppose the reduced rotation to be produced by the light reflected on the glass by the blackened surface, which light adds its effects to the light falling directly on the said blackened surface. This theory is in conformity with the well-known fact as stated by Crookes, that light A + light B gives one effect A + B, whatever be the respective situation of the lights on the circumference of a circle whose centre is the radiometer. I have no doubt that, by silvering the blackened hemisphere, which enlarges the reflecting power of the interior, the velocity of either rotation can be enlarged.

These remarks explain facts that, according to the dilatation theory, are a mere impossibility, the rotation in the same direction when a ray of light falls on the black or on the white side. These experiments can be made not only with a white or a black radiometer instead of alternate, but also with entirely transparent bulb, if light is predominant in one direction.

The difficulty in using the radiometer as a photometer is in the velocity of the revolutions. M. Gaiffe constructed for me a radiometer with a graduated screen which was in operation at La Villette Gas Works, and was sent to the lighthouse experimental establishment. Unfortunately that instrument requires a heliostat to send the rays into the aperture. Under that limitation the instrument works well, as the scale of proportion has been very easily established.

That reduction can be tried with a greater simplicity with a differential radiometer with plates differently coloured, the left with blue and the right with green or red. The rotation will be equal to the difference of rotating power, as demonstrated by the radiometer with both sides blackened. I suppose that white-blue + blue-black will give almost exactly the number of white-black, and that the rotating force might be so easily fragmentised. By a graduation all these different radiometers can be compared with each other.

Some of these radiometers are being constructed according to my suggestion by M. Gaiffe, and will be presented to the Academy as soon as the aforesaid theory shall have been demonstrated experimentally.

W. DE FONVIELLE

PROF. STEERE'S EXPEDITION TO THE PHILIPPINES

It may interest zoologists to know that an American gentleman, Prof. J. B. Steere, of the University of Michigan, has recently returned from an expedition to the Philippine Islands, bringing with him large collections of natural history objects. The birds he has submitted to me, and I am now engaged in preparing a memoir on the collection, which seems to be one of the most important ever made in the Indo-Malayan Islands. In spite of the great difficulties which meet the traveller in the Philippine group, and notwithstanding severe attacks of fever, Dr. Steere exerted himself with great energy, and as he visited many islands in which no previous collection had ever been made, it is not surprising that many novelties occur in the one he has now brought over to England for description.

Leaving Hongkong for Manila, in May, 1874, Dr. Steere crossed the Island of Luzon by way of Mauban and Lucban to the Pacific, passing some time on the mountain of Ma-hay-hay, near the Laguna de Bay. In July he went by steamer to the colony of Puerto Princesa, on the east side of the Island of Palawan, where he stayed a month. From thence he crossed to the Island of Balabac and remained a month, afterwards visiting the south-east corner of the Island of Mindanao, and resting for a month and a half at Zamboanga and the Indian village of Dumalon in the same province. The Island of Basilan, lying between Mindanao and the Sooloo group, was next visited, and here he stayed two weeks, after which he returned to Zamboanga and thence to Manila. In the month of December he again went south, stopping at Ilo Ilo, on the Island of Panay, and visiting the mountains in the interior. After a short stay at the neighbouring Island of Guimaras he crossed over to Negros, journeying on horseback round the north end of the island; thence in a native boat he traversed the sea to Zebu, which he crossed, till he arrived at the town of the same name, where he took horse again and rode southward, crossing the island once more and passing over the strait to the town of Dumaguete, on the Island of Negros. Dr. Steere then went back to Zebu and crossed to the Island of Bohol; after passing round part of this island he returned to Zebu and afterwards to Manila, where he visited the Negritos on the north side of the Bay of Manila, leaving finally in April for Singapore.

Full descriptions of the new species will shortly be prepared, but meanwhile I cannot avoid drawing attention to one or two of the most remarkable forms, chief amongst which will be the following :—

Eurylæmus Steerii, Sharpe. Unlike any other member of the *Eurylæmiacæ*, no species of which was previously known to inhabit the group. It has a grey back, white collar round the neck, the head and rump deep purplish, the tail chestnut; wings black with a yellow bar across the secondaries, white on the innermost; sides of face and throat black; rest of under surface white. The male differs in having the under surface purplish red. Hab. Basilan.

Phyllornis palawanensis, Sharpe, apparently different from every other *Phyllornis* by reason of its yellow throat, green under surface, and blue-edged primaries. There are other differences, but the above seems to be a combination of colouring not met with in the other species. Hab. Palawan.

Brachyurus Steerii, Sharpe. Green with a black head; shoulders and a band across the rump bright cobalt; tail black; below verditer blue or light cobalt, the throat white; centre of the abdomen black; vent and under tail-coverts crimson. Hab. Dumalon, Mindanao.

It is, however, among the sunbirds that Dr. Steere seems to have discovered the most curious novelties, as will be seen from the following birds :—

Æthopyga magnifica, Sharpe, resembles *Æ. flavostriata*, Wallace, from Celebes, but is larger, with a stronger bill, black belly, and is at once to be told by its black under-wing coverts. Hab. Negros.

Æthopyga Shelleyi, Sharpe, like *Æ. dabrii*, and *Æ. gouldiæ* in appearance, but without the elongated tail, and distinguishable at a glance by the entirely yellow under-surface, streaked on the breast with scarlet; the throat is yellow, bordered with a double moustachial line of scarlet and steel blue. Hab. Palawan.

Æthopyga pulcherrima, Sharpe, a small species, probably generically distinct. Above olive-green, with a steel blue frontal patch, and streak over the ear-coverts; wing-coverts, upper tail-coverts, and tail, metallic steel-green; rump yellow; wings olive; under-surface entirely